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## CLAIMS

1. A contaminant molecule sensor configured for use in a vacuum environment, the sensor comprising an electrochemical cell comprising a measurement electrode comprising a catalyst selected for its ability to catalyse the dissociation of a contaminant molecule into its ionic species, a reference electrode comprising a catalyst selected for its ability to catalyse the dissociation of a reference molecule into its ionic species, and a solid-state ionic species conductor bridging the measurement electrode and the reference electrode, the conductor being selected to conduct an ionic species common to the dissociated contaminant and reference molecules, and means for initiating the catalysis of the dissociation of the reference and contaminant molecules.
2. A sensor according to Claim 1, wherein the means for initiating the catalysis of the dissociation of the reference and contaminant molecules comprises means for controlling and monitoring the temperature of the cell.
3. A sensor according to Claim 2, comprising means for separating a reference environment space from a monitored environment space, the means for controlling and monitoring the temperature of the cell including a heating device contained within the reference environment space.
4. A sensor according to Claim 2 or Claim 3, wherein the means for controlling and monitoring the temperature includes an electrically powered heater.

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5. A sensor according to Claim 4, wherein the electrically powered heater comprises nichrome wire.
6. A sensor according to any of Claims 2 to 5, wherein the means for controlling and monitoring the temperature includes a temperature sensor.
7. A sensor according to Claim 6, wherein the temperature sensor is a thermocouple.
8. A sensor according to any preceding claim, comprising a vacuum feed-through connection for providing electrical connection to the measurement electrode.
9. A sensor according to any preceding claim, comprising seals for connection to a vacuum environment.
10. A sensor according to any preceding claim, wherein a reference environment space is at least partly bounded by the reference electrode and is open to the ambient atmosphere.
11. A sensor according to any of Claims 1 to 9, wherein a reference environment space is at least partly bounded by the reference electrode and is enclosed by a seal.
12. A sensor according to Claim 11, wherein electrical cables for connecting the electrodes and optionally an electric heating means with an electrical circuit external to the reference environment space pass through the seal.

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13. A sensor according to Claim 11 or Claim 12, comprising, in the reference environment space, a solid-state source of the reference molecules.
- 5 14. A sensor according to Claim 13, wherein the ionic species to be conducted is  $H^+$  and the solid-state source is selected from a metal, a metal/hydride, a metal alloy/metal-hydride, any hydrated species, and any organic species.
- 10 15. A sensor according to Claim 13, wherein the ionic species to be conducted is  $O^{2-}$  and the solid-state source is selected from a metal, a metal alloy and a metal oxide.
- 15 16. A sensor according to Claim 15, wherein the metal is copper (Cu) and the oxide is  $Cu_2O$ .
17. A sensor according to Claim 15, wherein the metal is chromium (Cr) and the oxide is  $Cr_2O_3$ .
- 20 18. A sensor according to Claim 15, wherein the metal is nickel (Ni) and the oxide is  $NiO$ .
19. A sensor according to Claim 13, wherein the ionic species to be conducted is  $Ag^+$  and the solid-state source is a silver salt.
- 25 20. A sensor according to Claim 19, wherein the solid state source is silver chloride.
- 30 21. A sensor according to Claim 11 or Claim 12, comprising, in the reference environment space, a liquid state source of the ionic species.

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22. A sensor according to Claim 21, wherein the ionic species to be conducted is  $H^+$  and the source comprises a liquid acid.
- 5 23. A sensor according to Claim 21, wherein the ionic species to be conducted is  $H^+$  and the source comprises an organic liquid.
24. A sensor according to Claim 11 or Claim 12, comprising, in the reference environment space, a gaseous state source of the ionic species.
- 10 25. A sensor according to any preceding claim, wherein the solid-state ionic species conductor conducts  $H^+$ .
- 15 26. A sensor according to Claim 25, wherein the solid-state species conductor is selected from  $CaZr_{0.9}In_{0.1}O_{3-x}$ ,  $BaZr_{0.9}Y_{0.1}O_{3-x}$ ,  $Ba_3Ca_{1.18}Nb_{1.82}O_{9-x}$ ,  $SrCe_{0.95}Yb_{0.05}O_{2.975}$  organic membranes, inorganic membranes, polymer membranes, Nafion<sup>TM</sup> and Nasicon<sup>TM</sup>.
- 20 27. A sensor according to any of Claims 1 to 24, wherein the solid-state ionic species conductor conducts  $O^{2-}$  ions.
28. A sensor according to Claim 27, wherein the solid-state species conductor comprises Yttria Stabilised Zirconia (YSZ).
- 25 29. A sensor according to any of Claims 1 to 24, wherein the solid-state ionic species conductor conducts  $Ag^+$ .
- 30 30. A sensor according to Claim 29, wherein the solid-state ionic species conductor comprises a silver salt.

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31. A sensor according to Claim 30, wherein the solid-state ionic species conductor is silver chloride.

5 32. A sensor according to any preceding claim, wherein the catalyst for the measurement electrode is the same as the catalyst for the reference electrode.

10 33. A sensor according to any preceding claim, wherein at least one of the catalysts comprises platinum.

34. A sensor according to any preceding claim, wherein at least one of the catalysts comprises ruthenium.

15 35. A sensor according to any preceding claim, wherein at least one of the catalysts comprises gold.

20 36. A sensor according to any preceding claim, wherein at least one of the catalysts comprises a catalysing oxide.

37. A sensor according to any preceding claim, wherein at least one of the catalysts comprises a silver salt.

25 38. A sensor according to any preceding claim, comprising means for monitoring a parameter of an electrical current produced in the cell, and means for calculating from the monitored parameter the partial pressure of the contaminant molecule in an environment on a side of the cell bounded by the measurement electrode relative to that on a side of the cell bounded by the reference electrode.

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39. A sensor according to Claim 38, wherein the monitoring means comprises an emf measuring device electrically connected to the reference and measuring electrodes.

5 40. A method of detecting or monitoring the presence of a contaminant molecule in a monitored environment, the method comprising the steps of providing an electrochemical cell comprising a measurement electrode comprising a catalyst selected for its ability to catalyse the dissociation of a contaminant  
10 molecule into its ionic species, a reference electrode comprising a catalyst selected for its ability to catalyse the dissociation of a reference molecule into its ionic species, and a solid-state ionic species conductor bridging the measurement electrode and the reference electrode, the conductor being selected to conduct an  
15 ionic species common to the dissociated contaminant and reference molecules, providing, on a side of the cell bounded by the reference electrode, a source of the reference molecules, initiating the catalysis of the reference and contaminant molecules, monitoring a parameter of an electrical current produced in the  
20 cell, and, from the monitored parameter, calculating the partial pressure of the contaminant molecule in an environment on the side of the cell bounded by the measurement electrode relative to that on the side of the cell bounded by the reference electrode.

25 41. A method according to Claim 40, wherein the monitored parameter is electromotive force.

42. A method according to Claim 40 or Claim 41, wherein catalysis of the contaminant molecule is initiated by heating the cell.

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43. A method according to any of Claims 40 to 42, wherein the reference molecule is the same as the contaminant molecule.

5 44. A method according to any of Claims 40 to 43, wherein the catalyst for the measurement electrode is the same as the catalyst for the reference electrode.

45. Use of an electrochemical sensor to detect or monitor the presence of contaminant molecule in a vacuum environment.  
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